US010190765B2

(12) United States Patent
Bell et al.

(10) Patent No.: US 10,190,765 B2
(45) Date of Patent: Jan. 29, 2019

(54) **HEAT EXCHANGER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 87 days.

(21) Appl. No.: **14/042,211**

(22) Filed: **Sep. 30, 2013**

(65) **Prior Publication Data**

US 2015/0090198 A1 Apr. 2, 2015

(51) **Int. Cl.**

F22B 1/16	(2006.01)
F28D 1/047	(2006.01)
F24H 1/22	(2006.01)
F24H 1/20	(2006.01)
F24H 9/18	(2006.01)
B65D 88/74	(2006.01)
F28D 1/02	(2006.01)

(52) **U.S. Cl.**

CPC ***F22B 1/167*** (2013.01); ***B65D 88/74*** (2013.01); ***F24H 1/208*** (2013.01); ***F24H 1/22*** (2013.01); ***F24H 9/1809*** (2013.01); ***F28D 1/0213*** (2013.01); ***F28D 1/0475*** (2013.01)

(58) **Field of Classification Search**

CPC ... F24J 2/345; F22B 1/167; F24H 1/44; F24H 1/22; F24H 9/1809; F28D 1/0475; F28D 1/0213; B65D 88/74

See application file for complete search history.

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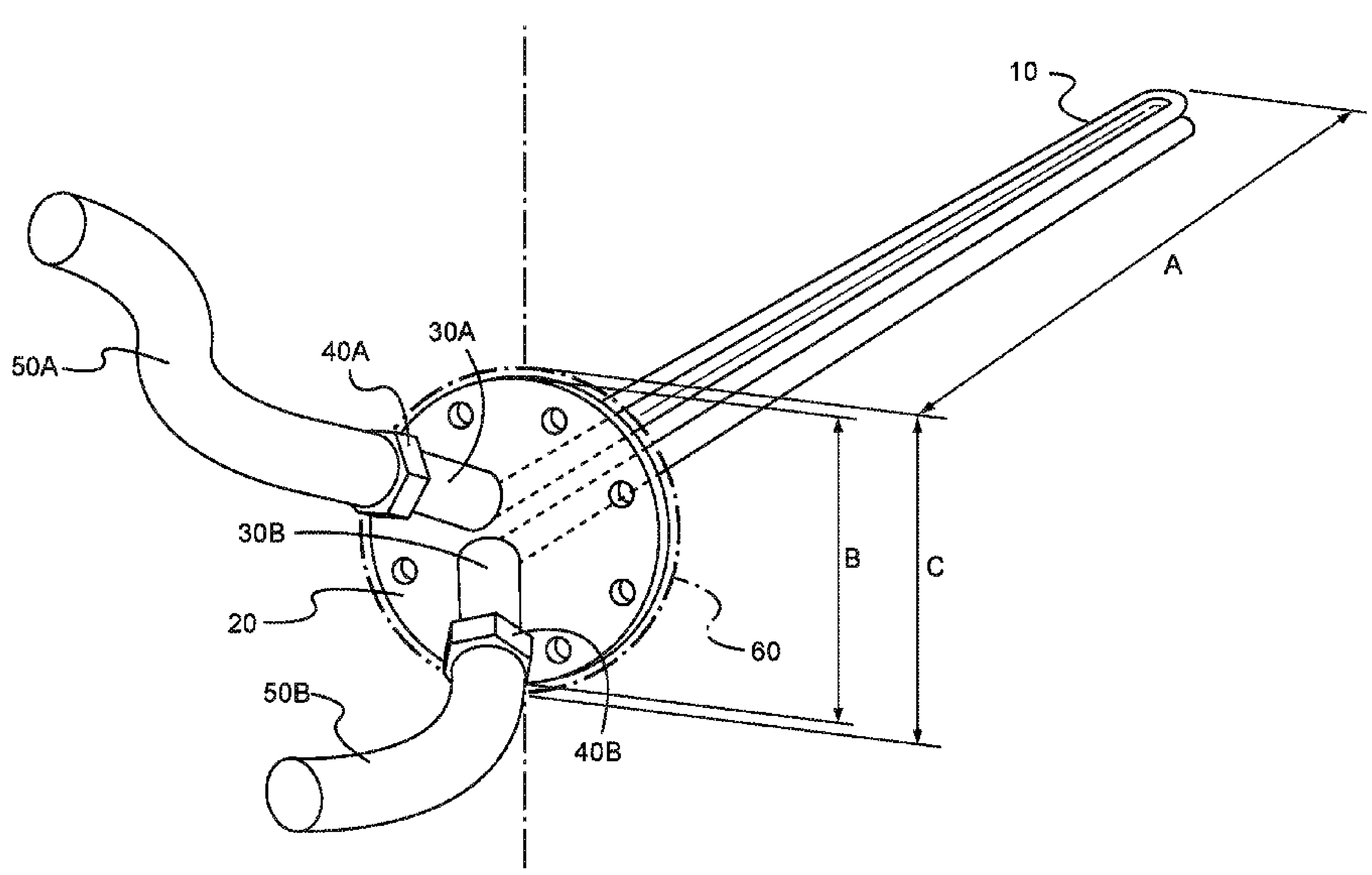
(57) **ABSTRACT**

A heat exchanger which is used primarily in oil and gas operations to heat tanks of liquids, such as drilling mud, water, heavy oil or other such fluids from freezing or becoming too viscous to pump.

17 Claims, 2 Drawing Sheets



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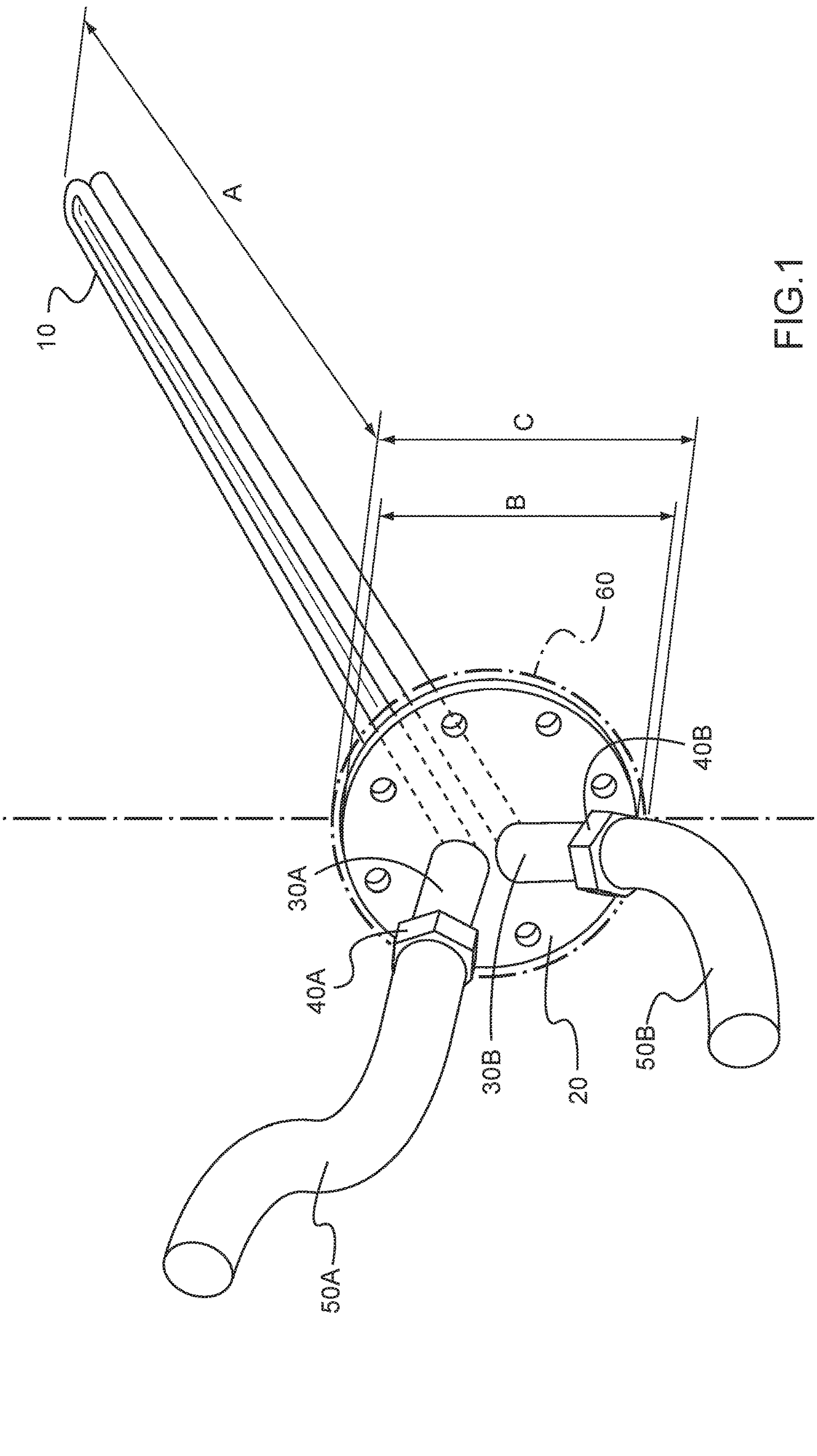

FIG.1

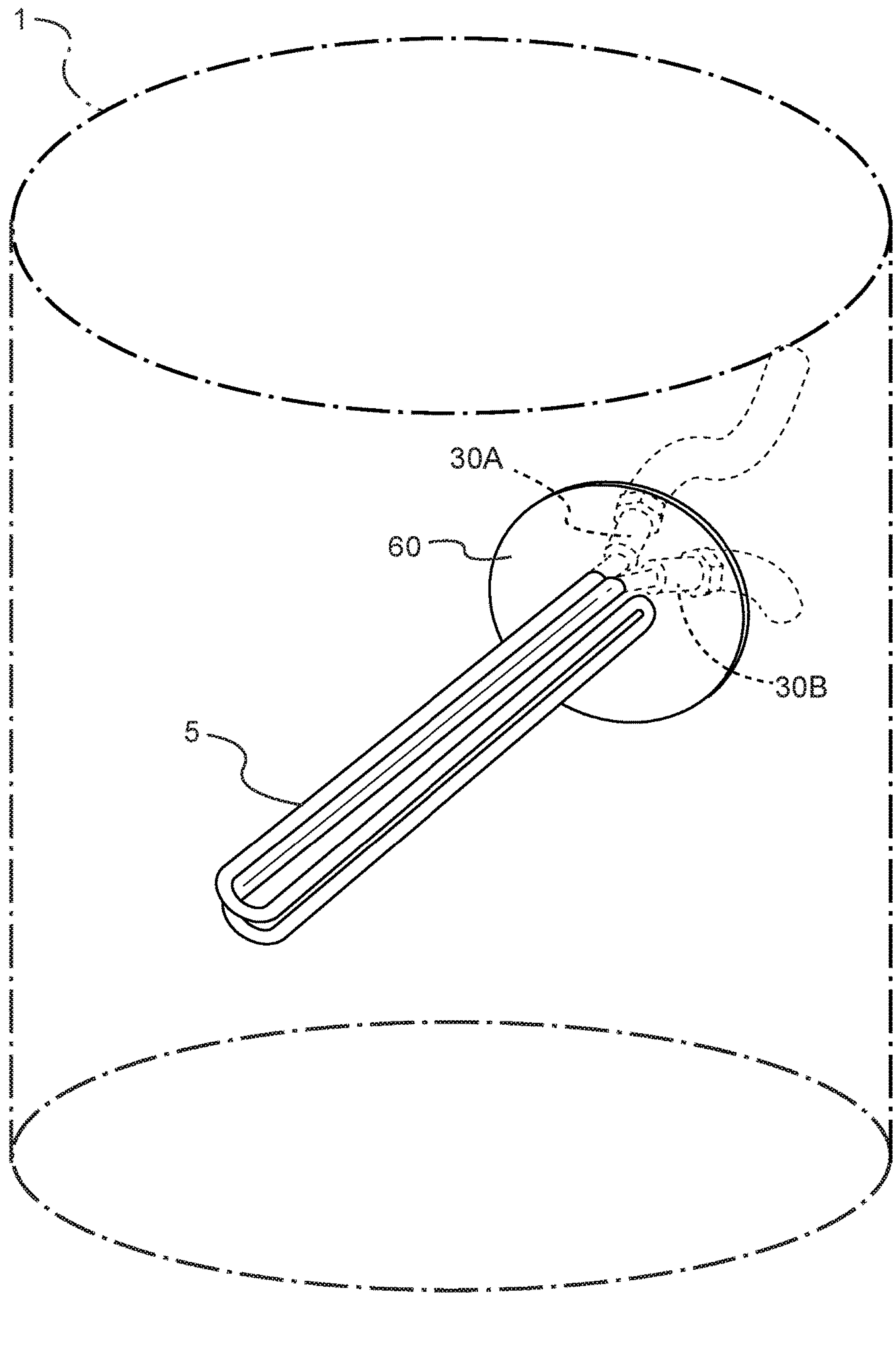

FIG.2

HEAT EXCHANGER

BACKGROUND

This invention generally relates to using a heat exchanger to prevent a tank containing liquid from freezing or to maintain the temperature of the liquid in a tank at a desired temperature.

Certain industrial applications require large volumes of heated fluid, primarily water, but not excluding other fluids such as drilling mud, hydrocarbons or caustic solutions. Although this patent application is not limited to any one of these types of fluids, this application will refer to these fluids as water. Also, although many types of fluids, such as glycol and oil, may be used as a heat generator fluid, this application will refer to glycol as the heat generator fluid.

Specific environments, such as that of the energy industry, may require that an open flame not be present. The fluid heating system and process described herein was created to heat fluids in such environments.

Common practice, for example, has been to truck water to several tanks located at the site of an oil or gas well. The water is typically heated by open flamed trucks which utilize, for example, diesel, natural gas or propane fired burners. However, these burners are inefficient (e.g., utilizing excessive amounts of fuel) and hazardous (e.g., causing fires, severe burns, and fatalities).

A flameless heat exchanger system removes these hazards by circulating hot glycol (e.g., temperature less than 100 degrees Celsius) within the tank, and returning it to the heat source. There is no risk of explosion or burns due to open flames or high temperature steam.

The heat exchanger may be installed by inserting it into a flanged opening (e.g., four inches in diameter) in the tank, when the tank is empty. Although a four inch flange is a standard size in the oil and gas industry, the heat exchanger can be any size, and can be inserted in any size of opening. When the tanks are filled, a heater is moved to the tank site, connected to the heat exchanger, and heats the water, or any other fluid contained in the tanks, to a desired temperature. The heater generates hot glycol, which is pumped to the tanks, circulated through the heat exchanger, and returned to the heater.

This process may be continuous (or interrupted) and may be continued, for example, until the fluid in the tank is heated to the desired temperature. Multiple tanks can be heated, for example, by connecting them in series with hoses and quick connect couplers or with the use of a manifold and connected in parallel. The heating process is efficient and safe.

SUMMARY

One aspect of the present invention includes a heat transfer tube, a flange, and quick connect adaptors. The heat transfer tube is configured such that the length of the tube is long enough to provide maximum amount of heating area within the tank, yet shorter than the diameter of the tank. The tube may be configured to include one or more bends and differing lengths or tubing, depending on the tank flange size. The flange is configured to have approximately the same diameter as the tank flange, which can be any size required for the tank. Quick connect adapters may be used so that hoses (e.g., which supply the glycol) can be quickly coupled and uncoupled from the heat exchanger, which are providing the hot glycol.

BRIEF DESCRIPTION OF THE DRAWINGS

The following drawings illustrate examples of various components of the invention disclosed herein, and are for illustrative purposes only.

FIG. **1** is a drawing one embodiment of a heat exchanger; and

FIG. **2** is a drawing of one embodiment of a heat exchanger inside a tank.

DETAILED DESCRIPTION

While the present invention may be embodied in many different forms, a number of illustrative embodiments are described herein with the understanding that the present disclosure is to be considered as providing examples of the principles of the invention and such examples are not intended to limit the invention to preferred embodiments described herein and/or illustrated herein

Reference will now be made to FIGS. **1** and **2**, a more detailed description of the heat exchanger process. Each component will be described in detail, followed by an overview of the heat exchanger process.

The largest component of heat exchanger **1**, for example, is heat transfer tube **10**. In this example, heat transfer tube **10** (e.g., may be multiple tubes) is constructed of stainless steel (e.g., provides corrosion resistance for caustic fluids); however, it is known to use any similar non-corrosive material, such as steel, or copper. The heat transfer tube **10** can be constructed of varying sizes, mainly dependent on the flange size of the tank that it is inserted into. The heat transfer tube **10** may be configured to include one or more bends, depending, in part on the tank flange size.

Attached to the heat transfer tubes **10** is heat exchanger flange **20**. In this example, heat exchange flange **20** is constructed of the same material as the heat exchanger tubes (e.g., stainless steel); however, it is known to use any similar non-corrosive material, such as steel, or copper. The heat exchange flange **20** is attached to or formed integral with the heat transfer tube **10**. In this example, the heat exchange flange **20** is welded to the heat transfer tube **10**. However, one of ordinary skill in the art would connect the flange **20** to the tube **10** in any safe and secure manner. In this example, the heat exchange flange **20** includes a plurality of through holes having a smaller diameter, for example, than an opening in the tank flange **60** described below. The through holes are configured to allow the heating fluid (e.g., hot glycol) to circulate to the heat transfer tubes **10**.

Pipes **30**A and **30**B are attached to an opposite side of the heat exchanger flange **20** as the heat transfer tube **10**.

The pipes **30**A and **30**B are attached to or formed integral with a surface of the heat exchanger flange **20**. In this example, the pipes **30**A and **30**B are welded to the surface. Quick connect couplers **40**A and **40**B are attached to an end of the pipes **30**A and **30**B that is away from the surface of the heat exchanger flange **20**. In this example, the quick connect couplers **40**A and **40**B are hydraulic quick connect couplers and are screwed on to the end of the pipes **30**A and **30**B. The quick connect couplers **40**A and **40**B are arranged between the pipes **30**A and **30**B and hoses **50**A and **50**B. The quick connect couplers **40**A and **40**B are configured to connect the hoses **50**A and **50**B to the pipes **30**A and **30**B in order to transfer a heated fluid (e.g., hot glycol) to the heat exchanger **1**. The hoses **50**A and **50**B can be constructed of various dimensions and can be connected to other hoses or a heater with quick connect couplers, such as the type described above.

Tank flange **60** is attached to or formed integral with a surface of tank **1** (e.g., drum), as shown in FIG. **2**. In this example, the tank flange **60** is welded to the tank **1**. The tank flange **60** may be configured of varying dimensions, preferably having a diameter approximately the same as that of the heat exchanger flange **20**. In this example, the tank flange **60** has approximately the same diameter as the heat exchanger flange **20**. An opening (through hole) is formed in the tank flange and is configured to accommodate the passage of the heat transfer tubes **10** into the tank **1**. In this example, the opening is approximately four-inches in diameter. However, one of ordinary skill in the art would utilize varying sizes that are appropriate.

The tank flange **60** may include a pipe having the same diameter as the opening formed in the tank flange **60** and extending from the tank flange **60** into the tank **1**. In this example, a bolt pattern formed on the tank flange **60** is designed to match a bolt pattern formed on the heat transfer flange **20** so that the tank flange **60** can be fixed to the heat transfer flange such that the heat transfer tubes **10** extend through the pipe of tank flange **60** and into the tank **1**.

In this example, hot glycol travels through the hose **50**A, which is connected to the quick connect coupler **40**A and then flows into the drum through a first opening in the flanges **20**, **60** to an inside of the heat transfer tube **10** arranged inside the drum. The glycol continuously flows inside the heat transfer tube **10** (e.g., generally u-shaped in this example) and exits the drum through a second opening in the flanges **20**, **60** to the quick connect coupler **40**B and then exits the heat exchanger through the hose **50**B.

The process can be reversed so that either coupler can be a used as an intake or exit for the hot glycol. The hot glycol can be pumped through the heat exchanger continuously or intermittently as required.

Although an embodiment of the instant invention has been described above and illustrated in the accompanying drawing in order to be more clearly understood, the above description is made by way of example and not as a limitation to the scope of the instant invention. It is contemplated that various modifications apparent to one of ordinary skill in the art could be made without departing from the scope of the invention which is to be determined by the following claims.

We claim:

1. A tank and heat exchanger apparatus, comprising:

a tank comprising a through-hole formed in a tank flange attached to an exterior surface of said tank; and

a heat exchanger comprising:

a flange; and

at least one heat transfer tube directly mounted on a first surface of the flange, opposing ends of the at least one heat transfer tube arranged in fluid communication with a corresponding intake port and exit port extending through the flange, wherein

the at least one heat transfer tube is configured to extend into an interior of said tank through the through-hole formed in the tank flange,

the first surface of the flange is mounted against and attached to the tank flange,

the flange comprises a bolt pattern designed to overlap with a bolt pattern formed on the tank flange so that the flange can be attached to the tank flange, and

the at least one heat transfer tube is in direct contact with material stored in the tank.

2. The tank and heat exchanger apparatus of claim **1**, wherein the corresponding intake port and exit port are each adapted to be mounted to a hose.

3. The tank and heat exchanger apparatus of claim **2**, wherein the corresponding intake port and exit port each comprise a pipe mounted on a second surface of the flange.

4. The tank and heat exchanger apparatus of claim **3**, wherein the second surface is an opposing surface to the first surface.

5. The tank and heat exchanger apparatus of claim **1**, wherein the corresponding intake port and exit port are each provided with a coupling for mounting to a hose.

6. The tank and heat exchanger apparatus of claim **1**, wherein the at least one heat transfer tube comprises a substantially U-shaped tube, wherein a bend portion of the U-shaped tube is positioned away from the flange.

7. The tank and heat exchanger apparatus of claim **6**, wherein

the bend portion of the U-shaped tube defines a first portion and a second portion,

the first portion comprises a first one of the opposing ends of the at least one heat transfer tube, and

the second portion comprises a second one of the opposing ends of the at least one heat transfer tube.

8. The tank and heat exchanger apparatus of claim **1**, comprising a single heat transfer tube bent in a plurality of U-shaped bend portions.

9. The tank and heat exchanger apparatus of claim **8**, the single heat transfer tube being bent in a first U-shaped bend portion thus defining first and second portions, the first portion comprising a first one of the opposing ends, the second portion comprising a second one of the opposing ends,

the first portion being bent in a second U-shaped bend portion and second portion being bent in a third U-shaped bend portion,

the first U-shaped bend portion positioned proximal to the flange, the second and third U-shaped bend portions positioned distal to the flange.

10. The tank and heat exchanger apparatus of claim **1**, wherein the at least one heat transfer tube comprises stainless steel.

11. The tank and heat exchanger apparatus of claim **1**, wherein the at least one heat transfer tube is formed integrally with the flange.

12. The tank and heat exchanger apparatus of claim **1**, wherein the at least one heat transfer tube extends substantially perpendicularly from the flange.

13. The tank and heat exchanger apparatus of claim **1**, further comprising a first and second hose attached to the corresponding intake port and exit port, respectively.

14. A plurality of the tank and heat exchanger apparatuses combinations of claim **13**, connected to one another in series or in parallel.

15. The tank and heat exchanger apparatus of claim **1**, wherein said through-hole has a diameter of four-inches.

16. The tank and heat exchanger apparatus of claim **1**, wherein the through-hole is formed on a wall of said tank.

17. The tank and heat exchanger apparatus of claim **1**, wherein the at least one heat transfer tube is configured to have a heating fluid circulated through the at least one heat transfer tube.

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